

Appl. No. : 10/669,081
Filed : September 23, 2003

AMENDMENTS TO THE DRAWINGS

The attached sheets of drawings include changes to Figures 7A, 7B, 8-12 and 14. Per the Examiner's request, a line between the top surfaces of metal contacts 700 was removed in Figures 7A, 8-12 and 14 to avoid any implication that the space between the contacts is filled. In addition, a reference number 700 pointing to the metal contact on the left side of the drawing was added in Figures 11, 12 and 14. Applicants also modified a cut line in Figure 7B to clarify that Figure 7A illustrates a cross-sectional view, rather than a side view, as indicated in paragraph [0041] of the originally filed disclosure. No new matter has been added.

Attachment: Replacement Sheets 4/9, 5/9, 6/9, 7/9 and 9/9.

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REMARKS

The March 16, 2005 Office Action was based upon pending Claims 1-24. This Amendment amends Claims 1, 3-5, 7-12, 15, 16, 18 and 20-23 and adds new Claims 27 and 28. Thus, after entry of this Amendment, Claims 1-24, 27 and 28 are pending and presented for further consideration.

I. RESPONSE TO DRAWING OBJECTIONS

The Examiner objected to the drawings because, in Figures 7A, 8-12 and 14, there is shown a line between the top surfaces of metal contacts 700 implying that the space between the contacts is filled. However, the specification teaches and later figures show that the space is not filled. In response, Applicants have amended Figures 7A, 7B, 8-12 and 14 as set forth in the above section entitled "AMENDMENTS TO THE DRAWINGS." Applicants respectfully request that the objections to the drawings be withdrawn.

II. REJECTION OF CLAIMS 4-11 UNDER 35 U.S.C. § 102(e)

In the March 16, 2005 Office Action, the Examiner rejected Claims 4-11 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,686,580 to Glenn, et al. ("the Glenn patent"). In view of the above claim amendments and the following discussion, Applicants respectfully traverse this rejection. Although Applicants respectfully submit that the original claims are patentably distinguished over the Glenn patent, the other cited references or any combination thereof, Applicants have amended the claims herein in order to clarify the distinguishing features of Applicants' inventions.

A. Claim 4

Focusing in particular on Claim 4 and the embodiment shown in Figure 3, an optoelectronic device 300 is formed on a front side 302 of a semiconductor wafer 312 in an integrated circuit fabrication process. At least one electrical contact 306 on a backside 308 of the semiconductor wafer 312 is coupled to the optoelectronic device 300 through a via 310 in the semiconductor wafer 312.

Referring to Figure 2 of the Glenn patent, the Glenn patent appears to disclose an image sensor 106 that is attached to an upper surface 102U of a substrate 102 with vias 215 in the substrate 102 coupling the image sensor 106 to conductive traces 216 on the lower surface 102L of the substrate 102. The Glenn patent does not suggest an integrated circuit fabrication process with a semiconductor wafer substrate. Rather, the Glenn patent teaches that the substrate 102 is a moisture resistant material such as liquid crystal polymer (or a thermoplastic substrate, an alumina-based ceramic substrate, a printed circuit board substrate, a plastic glass laminated substrate or a tape-based substrate). The Glenn patent also teaches that the image sensor 106 is attached by an adhesive layer 108 (or materials such as solder) to the upper surface 102U of the substrate 102.

Because the references cited by the Examiner do not disclose, teach or suggest forming an optoelectronic device on a front side of a semiconductor wafer in an integrated circuit fabrication process with a via coupling the optoelectronic device to an electrical contact on a backside of the semiconductor wafer, Applicants assert that Claim 4 is not anticipated by the Glenn patent or the other cited references. Applicants therefore respectfully submit that Claim 4 is patentably distinguished over the cited references and Applicants respectfully request allowance of Claim 4.

B. Claims 5-11

Claims 5-11, which depend from Claim 4, are believed to be patentable for the same reasons articulated above with respect to Claim 4, and because of the additional features recited therein.

III. REJECTION OF CLAIMS 12-18, 23 AND 24 UNDER 35 U.S.C. § 102(e)

The Examiner rejected Claims 12-18, 23 and 24 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,614,103 to Durocher, et al. ("the Durocher patent"). In view of the above claim amendments and the following discussion, Applicants respectfully traverse this rejection. Although Applicants respectfully submit that the original claims are patentably distinguished over the Durocher patent, the other cited references or any combination thereof, Applicants have amended the claims herein in order to clarify the distinguishing features of Applicants' inventions.

A. Claim 12

Claim 12 is directed to an array of optoelectronic devices formed on a front side of a semiconductor wafer. A corresponding array of electrical contacts on a backside of the semiconductor wafer is electrically coupled to the optoelectronic devices by respective vias through the semiconductor wafer.

Referring to Figure 13 of the Durocher patent, the Durocher patent appears to disclose an array of light emitting diode (LED) chips 59 mounted in rigid insulating carriers 21 which are attached to a first side of a flexible module base 41. Vias through the flexible module base 41 can be used to electrically couple the LED chips 59 to conductive patterns 47 on a second side of the flexible module base 41. The Durocher patent teaches that the rigid insulating carriers 21 are attached to the first side of the flexible module base 41 using an anisotropic conductive adhesive layer 53 or any suitable adhesive layer 55 such as contact adhesive, epoxy or a cyanoacrylate adhesive. The Durocher patent teaches that the flexible module base 41 is preferably a flexible plastic sheet or a flexible epoxy/glass circuit board.

Because the references cited by the Examiner do not disclose, teach or suggest forming an array of optoelectronic devices on a front side of a semiconductor wafer with vias coupling the optoelectronic devices to a corresponding array of electrical contacts on a backside of the semiconductor wafer, Applicants assert that Claim 12 is not anticipated by the Durocher patent or the other cited references. Applicants therefore respectfully submit that Claim 12 is patentably distinguished over the cited references and Applicants respectfully request allowance of Claim 12.

B. Claims 13 and 14

Claims 13 and 14, which depend from Claim 12, are believed to be patentable for the same reasons articulated above with respect to Claim 12, and because of the additional features recited therein.

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C. Claim 15

Claim 15 is directed to a photodiode formed on a front side of a semiconductor wafer in fabrication of an integrated circuit. A first contact on a back side of the semiconductor wafer is electrically coupled to an anode of the photodiode by a first via through the semiconductor wafer. A second contact on the back side of the semiconductor wafer is electrically coupled to a cathode of the photodiode by a second via through the semiconductor wafer.

The Durocher patent does not appear to disclose, teach or suggest forming a photodiode on a front side of a semiconductor wafer in fabrication of an integrated circuit with vias to electrically couple the photodiode to contacts on a back side of the semiconductor wafer. Thus, Applicants assert that Claim 15 is not anticipated by the Durocher patent. Applicants therefore respectfully submit that Claim 15 is patentably distinguished over the cited references and Applicants respectfully request allowance of Claim 15.

D. Claims 16-18

Claims 16-18, which depend from Claim 15, are believed to be patentable for the same reasons articulated above with respect to Claim 15, and because of the additional features recited therein.

E. Claim 23

Claim 23 is directed to a laser diode formed on a front side of a semiconductor wafer. Contacts formed on a backside of the semiconductor wafer are electrically coupled to the laser diode by electrically conductive via holes through the semiconductor wafer. Because the Durocher patent does not appear to disclose, teach or suggest a laser diode formed on a front side of a semiconductor wafer with via holes electrically coupling the laser diode to contacts formed on a backside of the semiconductor wafer, Applicants asserts that Claim 23 is not anticipated by the Durocher patent. Applicants therefore respectfully submit that Claim 23 is patentably distinguished over the cited references and Applicants respectfully request allowance of Claim 23.

F. Claim 24

Claim 24, which depends from Claim 23, is believed to be patentable for the same reasons articulated above with respect to Claim 23, and because of the additional features recited therein.

IV. REJECTION OF CLAIMS 1-3 AND 19-22 UNDER 35 U.S.C. § 103(a)

The Examiner rejected Claims 1-3 and 19-22 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,348,682 to Lee ("the Lee patent") in view of the Durocher patent. In view of the above claim amendments and the following discussion, Applicants respectfully traverse this rejection. Although Applicants respectfully submit that the original claims are patentably distinguished over the Lee patent, the Durocher patent, the other cited references or any combination thereof, Applicants have amended the claims herein in order to clarify the distinguishing features of Applicants' inventions.

A. Claim 1

Claim 1 is directed to an optical receiver module with a photodiode chip and a transimpedance amplifier chip. The photodiode chip has a PIN photodiode formed on a front side of a semiconductor wafer and electrical contacts to the PIN photodiode formed on a backside of the semiconductor wafer. The transimpedance amplifier chip has electrical terminals coupled to the backside of the photodiode chip by solder bumps to form a chip-on-chip module.

Neither the Lee patent nor the Durocher patent disclose, teach or suggest a photodiode chip with a PIN photodiode formed on a front side of a semiconductor wafer and electrical contacts to the PIN photodiode formed on a backside of the semiconductor wafer. Accordingly, Applicants respectfully submit that Claim 1 is patentably distinguished over the cited references and Applicants respectfully request allowance of Claim 1.

B. Claims 2 and 3

Claims 2 and 3, which depend from Claim 1, are believed to be patentable for the same reasons articulated above with respect to Claim 1, and because of the additional features recited therein.

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C. Claims 19-22

Claims 19-22, which depend from Claim 15, are believed to be patentable for the same reasons articulated above with respect to Claim 15, and because of the additional features recited therein.

V. CONCLUSION

Applicants have endeavored to address all of the Examiner's concerns as expressed in the outstanding Office Action. In light of the above remarks, reconsideration and withdrawal of the outstanding rejections is specifically requested.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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